DIESEL: ELECTRONICS

COURSE DESCRIPTION

Diesel: Electronics is a course offering training in the diagnosis and repair of the electrical systems of medium and heavy trucks. Students apply principles of electricity and electronics to diesel technology and develop diagnostic skills. The course provides training in the use of electrical test equipment such as digital multimeters (DMM) and ammeters. Course content prepares students for entry level employment in diesel electrical and electronics, continuing education in diesel technology and post secondary education. Students completing the *Diesel: Electronics* course will be eligible to take the ASE written examination for Electrical and Electronics in Medium/Heavy Trucks.

Prerequisite(s): Transportation Core

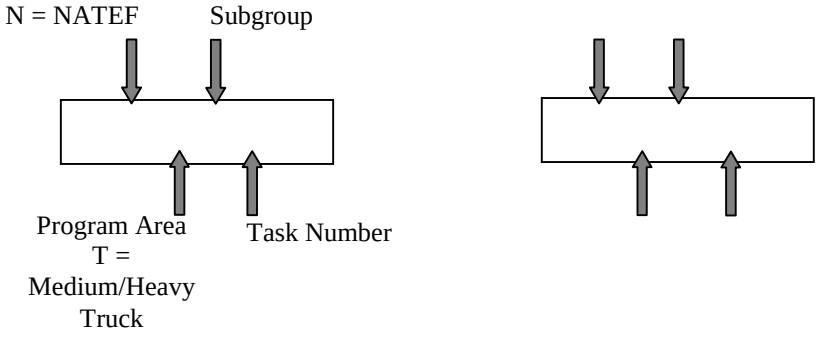
Algebra I or Math for Technology II; Physical Science or Principles of Technology I, (may be concurrent)

Required: A minimum of 225 hours must be dedicated to diesel electrical/electronic systems to meet minimum standards set by NATEF.

Recommended Credits: 2

Recommended Grade Level(s): 10th, 11th, or 12th

Notes: Course is aligned with NATEF tasks list for medium/heavy trucks. Items have been organized based on the requirements of the state-required course description format. NATEF tasks are referenced with the corresponding Performance Standards.. Codes are



DIESEL: ELECTRONICS STANDARDS

1.0 Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

2.0 Students will demonstrate diesel technology safety practices, including Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) requirements for a diesel repair facility.

3.0 Students will properly test and diagnose general electrical systems.

4.0 Students will properly test, diagnose, and repair battery, starting system, and charging system.

5.0 Students will properly test, diagnose, and repair lighting systems.

6.0 Students will properly test, diagnose, and repair related electrical systems.

7.0 Students will demonstrate communication skills required in the diesel service industry.

8.0 Students will demonstrate interpersonal and employability skills required in the diesel service industry.

DIESEL: ELECTRONICS

STANDARD 1.0

Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

LEARNING EXPECTATIONS

The student will:
1.1 Lead a team.
1.2 Participate in SkillsUSA-VICA as an integral part of classroom instruction.
1.3 Assess client complaint and apply problem-solving and decision-making skills to communicate with the client.
1.4 Demonstrate teamwork skills.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:
1.1.A As a team leader, demonstrates character and leadership skills to accomplish a project.
1.1.B Evaluates the effectiveness of a team and develops a plan for improvement.
1.2.A Applies the points of the creed and purposes of SkillsUSA-VICA in the classroom and laboratory.
1.2.B Demonstrates rules of parliamentary procedure to express ideas to a group.
1.3.A Analyzes situations in the workplace and uses conflict resolution techniques to solve the problem.
1.3.B Follows work order and communicates with client.
1.4 Participates in a group to diagnose electrical systems.

SAMPLE PERFORMANCE TASKS

- Analyze the classroom and laboratory structure. Compile a proposal to organize the classroom and laboratory to show improvement in effectiveness.
- Participate in various SkillsUSA-VICA programs and/or competitive events.
- Evaluate an activity within the school, community, and/or workplace and develop a plan for improvement using teamwork skills.
- Implement an annual program of work.
- Prepare a meeting agenda for a SkillsUSA-VICA monthly meeting.
- Attend a professional organization meeting or trade show relating to the automotive service industry.

INTEGRATION LINKAGES

SkillsUSA-VICA, *Professional Development Program*, SkillsUSA-VICA, Communications and Writing Skills, Teambuilding Skills, Research, Language Arts, Sociology, Psychology, Math, Math for Technology, Applied Communications, Social Studies, Problem Solving, Interpersonal Skills, Employability Skills, Critical-Thinking Skills, SCANS (Secretary's Commission on Achieving Necessary Skills), Chamber of Commerce, Colleges, Universities, Technology Centers, and Employment Agencies

DIESEL: ELECTRONICS

STANDARD 2.0

Students will demonstrate diesel technology safety practices, including Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) requirements for a diesel repair facility.

LEARNING EXPECTATIONS

The student will:

2.1 Determine the safe and correct application for chemicals used in a diesel repair facility.
2.2 Use protective clothing and safety equipment.
2.3 Use fire protection equipment.
2.4 Follow OSHA and EPA regulations affecting diesel service technology.
2.5 Respond to safety communications.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

2.1.A Conforms to federal, state, and local regulations when handling, storing, and disposing of chemicals.
2.1.B Ensures proper ventilation for chemical use.
2.1.C Locates first aid supplies.
2.2.A Demonstrates proper usage of special safety equipment.
2.2.B Selects and uses the appropriate protective clothing for a given task.
2.2.C Demonstrates the use of eye protection.
2.3.A Chooses the proper fire extinguisher for each class of fire.
2.3.B Demonstrates the proper use of a fire extinguisher.
2.4.A Locates regulatory information.
2.4.B Extracts information from Material Safety Data Sheets pertaining to shop chemicals.
2.4.C Complies with relevant regulations and standards.
2.5.A Interprets safety signs and symbols.
2.5.B Complies with safety signs and symbols.

SAMPLE PERFORMANCE TASKS

- Assess the work area for safety hazards.
- Design a corrections program for identified hazards.
- Model the appropriate protective equipment for an assigned task.

INTEGRATION LINKAGES

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA)

DIESEL: ELECTRONICS

STANDARD 3.0

Students will properly test and diagnose general electrical systems.

LEARNING EXPECTATIONS

The student will:

3.1 Analyze the function and operation of medium and heavy truck general electrical systems.

3.2 Test and diagnose general electrical systems to determine needed action.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

3.1.A Correlates the following electrical and magnetic concepts with their role in medium and heavy truck electrical system functions and operation:

- valence
- voltage
- current
- resistance
- field distance
- voltage drop
- magnetism
- electromagnetism
- electromagnetic induction
- magnemotive force
- magnetic force
- reluctance

3.1.B Compares the two theories of current flow and indicates which theory is used in automotive technology.

3.1.C Distinguishes between conductor, insulator, and semi-conductor.

3.1.D Distinguishes between DC (direct current) and AC (alternating current).

3.1.E Deduces the cause and effect relationship in Ohm's law between voltage, current, resistance, and voltage drop and uses the law to determine values mathematically.

3.1.F Analyzes series, parallel, and series-parallel circuit structure both in application and mathematically.

3.2.A Reads, interprets, and diagnoses electrical/electronic circuits using wiring diagrams.

3.2.B Checks continuity in electrical/electronic circuits using appropriate test equipment.

3.2.C Uses a digital multimeter (DMM) to check the following in electrical/electronic circuits and components:

- applied voltages,
- circuit voltages,
- voltage drops,
- current, flow and resistance.

3.2.D Finds shorts, grounds, and opens in electrical/electronic circuits.

3.2.E Diagnoses parasitic (key-off) battery drain problems.

3.2.F Inspects and tests the following and replaces as needed:

- fusible links,
- circuit breakers,
- relays,
- solenoids,
- fuses, and
- spike suppression diodes/resistors.

SAMPLE PERFORMANCE TASKS

- Troubleshoot electrical circuits and find cause of problem.
- Correctly diagnose a failed electrical component.
- Use a digital multimeter (DMM) to check the applied voltage in an electrical circuit.
- Use a wiring diagram to diagnose an electrical/electronic circuit.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

INTEGRATION LINKAGES

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), Secretary's Commission on Achieving Necessary Skills (SCANS)

DIESEL: ELECTRONICS

STANDARD 4.0

Students will properly test, diagnose, and repair battery, starting system, and charging system.

LEARNING EXPECTATIONS

The student will:

4.1 Analyze the function and operation of the battery, starting system, and charging system.
4.2 Test, diagnose, service, and repair battery.
4.3 Test, diagnose, service, and repair starting system
4.4 Test, diagnose, service, and repair charging system.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

4.1.A Analyzes the function and operation of the battery.
4.1.B Interprets battery ratings and capacity.
4.1.C Demonstrates battery safety procedures.
4.1.D Analyzes the principles, functions, and operation of each of the following:
- starting system and components,
- electric motor,
- charging system, and
- generator.

4.1.E Examines the use and operation of circuit components that use electromagnetic induction and magnetism, including starters, relays, and solenoids.
4.2.A Performs battery load test and determines needed action.
4.2.B Determines battery state of charge using an open circuit voltage test and charges battery using slow or fast charge method as needed.
4.2.C Inspects, cleans, and services battery; replaces as needed.
4.2.D Inspects and cleans battery boxes, mounts, and hold downs; repairs or replaces as needed.
4.2.E Inspects, tests, and cleans battery cables and connectors; repairs or replaces as needed.
4.2.F Jump-starts a vehicle with jumper cables and a booster battery or auxiliary power supply using proper safety procedures.
4.3.A Performs starter current draw test and determines needed action.
4.3.B Performs starter circuit cranking voltage and voltage drop tests and determines needed action.
4.3.C Inspects, tests, and replaces components (key switch, push button and/or magnetic switch) and wires in the starter control circuit.
4.3.D Inspects, tests, and replaces starter relays and solenoids/switches.
4.3.E Removes and replaces starter.
4.3.F Inspects flywheel ring gear or flex plate.
4.4.A Diagnoses instrument panel mounted volt meters and/or indicator lamps that show a no charge, low charge, or overcharge condition; diagnoses the cause of a no charge, low charge, or overcharge condition; and determines needed action.
4.4.B Inspects, adjusts, and replaces alternator drive belts, pulleys, fans, tensioners, and mounting brackets.
4.4.C Performs the following tests and determines necessary action:
- charging system voltage and amperage output test, and
- charging circuit voltage drop tests.

4.4.D Removes and replaces alternator.
4.4.E Inspects, repairs, or replaces connectors and wires in the charging circuit.
4.4.F Diagnoses AC voltage leakage (failed rectifier) at alternator output and determines needed action.

SAMPLE PERFORMANCE TASKS

- Determine a vehicle's battery state of charge and charge the battery using either the slow or fast charge method as appropriate.
- Diagnose a starting problem and determine and perform needed repair or replacement.
- Demonstrate correct procedure for jump-starting a vehicle.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

INTEGRATION LINKAGES

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), Secretary's Commission on Achieving Necessary Skills (SCANS)

DIESEL: ELECTRONICS

STANDARD 5.0

Students will properly test, diagnose, and repair lighting systems.

LEARNING EXPECTATIONS

The student will:

5.1 Analyze the function and operation of lighting systems.
5.2 Test, diagnose, and adjust or repair headlights, daytime running lights, and parking, clearance, tail, cab, and instrument panel lights.
5.3 Test, diagnose, and adjust or repair stoplights, turn signals, hazard lights, and back-up lights.
5.4 Test, diagnose, and adjust or repair gauges and warning devices.
5.5 Test, diagnose, and adjust or repair related electrical systems.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

5.1.A Demonstrates operation of the:
- brake and turn signal lights,
- dome lights,
- reverse lights, and
- headlights.

5.1.B Compares the different types of headlight systems.
5.1.C Categorizes the different types of gauges and sending units and explains how they operate.
5.1.D Categorizes the different types of warning lights and explains how they operate.
5.2.A Diagnoses the cause of brighter than normal, intermittent, dim, or no headlight and daytime running light (DRL) operation.
5.2.B Tests, aims, and replaces headlights.
5.2.C Tests headlight and dimmer circuit switches, relays, wires, terminals, connectors, sockets and control components; repairs or replaces as needed.
5.2.D Inspects and tests the following and repairs or replaces as needed:
- switches, bulbs/LEDs, sockets, connectors, terminals, relays and wires of parking, clearance, and taillight circuits;
- instrument panel light circuit switches, relays, bulbs, sockets, connectors, terminals, wires, and printed circuits/control modules;
- interior cab light circuit switches, bulbs, sockets, connectors, terminals, and wires;
- tractor-to-trailer multi-wire connectors.

5.3.A Inspects, tests, and adjusts stoplight circuit switches, bulbs/LEDs, sockets, connectors, terminals, and wires; repairs or replaces as needed.
5.3.B Inspects and tests turn signal and hazard circuit flasher(s), switches, relays, bulbs/LEDs, sockets, connectors, terminals, and wires; repairs or replaces as needed.
5.3.C Inspects, tests, and adjusts backup lights and warning device circuit switches, bulbs/LEDs, sockets, horns, buzzers, connectors, terminals, and wires; repairs or replaces as needed.
5.4.A Interfaces with vehicle's on-board computer; performs diagnostic procedure using recommended electronic diagnostic equipment and tools (including PC based software and/or data scan tools); determines needed action.

5.4.B Diagnoses the cause of intermittent, high, low, or no gauge readings; determines needed action.
5.4.C Diagnoses the cause of data-bus-driven gauge malfunctions; determines needed action.
5.4.D Inspects and tests gauge circuit sending units, gauges, connectors, terminals, and wires; repairs or replaces as needed.
5.4.E Inspects and tests warning devices (lights and audible) circuit sending units, bulbs/LEDs, sockets, connectors, wires, and printed circuits/control modules; repairs or replaces as needed.
5.4.F Inspects, tests, replaces, and calibrates (if applicable) electronic speedometer, odometer, and tachometer systems.

SAMPLE PERFORMANCE TASKS

- Determine cause of a headlight problem and perform needed repair or replacement to solve problem.
- Determine cause of a problem with gauge readings and perform needed repair or replacement to solve problem.
- Inspect and test the speedometer and determine if calibration or replacement is required.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

INTEGRATION LINKAGES

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), Secretary's Commission on Achieving Necessary Skills (SCANS)

DIESEL: ELECTRONICS

STANDARD 6.0

Students will properly test, diagnose, and repair related electrical systems.

LEARNING EXPECTATIONS

The student will:

6.1 Analyze the function and operation of related electrical systems.
6.2 Examine the role of computer technology in truck service and repair.
6.3 Test, diagnose, and repair related truck electrical systems.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

6.1.A Illustrates the use and operation of automotive circuit components that use electromagnetic induction and magnetism, including alternators, motors, starters, relays, and solenoids.
6.1.B Examines the operation of cruise control systems.
6.1.C Correlates the various components of the radio and/or entertainment system with their functions and operation.
6.2.A Analyzes the operation and uses of the scan (scan tools) equipment in communicating with personal computers.
6.2.B Selects the appropriate computer technology or related technology equipment to prevent, identify, or solve problems; uses proper procedures for setup and operation of the equipment; and maintains and troubleshoots the equipment.
6.2.C Analyzes the operation and uses of the electronic service tools (EST) used in communicating with truck electronic control modules (ECM) and personal computers.
6.2.D Downloads files from a remote computer to a local computer and/or electronic service tools EST using a communications program to reprogram a truck on-board computer.
6.3.A Diagnoses the cause of the following and determines needed action:
- constant, intermittent, or no horn operation;
- constant, intermittent, or no wiper operation;
- wiper speed control and/or park problems; and
- slow, intermittent, or no power side window operation.

6.3.B Inspects and tests the following and repairs or replaces as needed:
- horn circuit relays, horns, switches, connectors, and wires;
- wiper motor, resistors, park switch, relays, switches, connectors, and wires;
- wiper motor transmission linkage, arms, and blades;
- windshield washer motor or pump/relay assembly, switches, connectors, terminals, and wires;
- sideview mirror motors, heater circuit grids, relays, switches, connectors, terminals, and wires;
- heater and A/C electrical components including: A/C clutches, motors, resistors, relays, switches, connectors, terminals, and wires;
- auxiliary power outlet, integral fuse, connectors, terminals, and wires; and
- motors, switches, relays, connectors, terminals, and wires of power side window circuits.

6.3.C Inspects block heaters and determines needed repairs.
6.3.D Inspects and tests cruise control electrical components; repairs or replaces as needed.

6.3.E Inspects and tests engine cooling fan electrical control components; repairs or replaces as needed.

SAMPLE PERFORMANCE TASKS

- Demonstrate the use of electronic service tools (EST).
- Determine cause of a problem with windshield wipers and perform needed repair or replacement to solve problem.
- Determine cause of a problem with cruise control system and perform needed component repair or replacement to solve problem.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

INTEGRATION LINKAGES

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), Secretary's Commission on Achieving Necessary Skills (SCANS)

DIESEL: ELECTRONICS

STANDARD 7.0

Students will demonstrate communication skills required in the diesel service industry.

LEARNING EXPECTATIONS

The student will:

7.1 Communicate and comprehend oral and written information pertaining to electrical and electronic systems.
7.2 Solve electrical problems and make decisions using a logical process.
7.3 Use teamwork skills to solve problems relating to electrical and electronic system issues.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

7.1.A Interprets and uses written information in common job formats, such as tables, charts, and reference materials and manuals to solve electrical and electronic system problems.
7.1.B Interprets and uses graphical information such as blueprints, electrical schematics, process control schematics, flow charts, and other diesel medium/heavy truck diagrams to solve electrical and electronic system problems.
7.1.C Uses electronic resources to obtain electrical and electronic service and other meduim/heavy truck information.
7.1.D Analyzes information obtained from various sources to determine an electrical and electronic diagnostic solution.
7.1.E Interprets a repair order for an electrical/electronic system.
7.2.A Develops a hypothesis regarding the cause of an electrical/electronic problem.
7.2.B Tests the hypothesis to determine the solution to the electrical/electronic problem.
7.2.C Creates, evaluates, and revises a plan to resolve a problem.
7.2.D Implements strategy based diagnostic procedure by verifying the complaint, defining the problem, isolating the problem, validating the problem, making repairs, and testing the repairs in an electrical/electronic system.
7.3.A Serves in each of the functional roles of a team.
7.3.B Resolves conflicts within a group.
7.3.C Demonstrates appropriate and positive examples of giving and accepting criticism.
7.3.D Modifies behavior or revises work based on appropriate criticism.
7.3.E Solves problems in cooperation with other members of a group.
7.3.F Evaluates the role of the automotive technician within the organizational system of a dealership or fleet shop.

SAMPLE PERFORMANCE TASKS

- Complete a repair order.
- Use reference materials to determine procedures for diagnosing and testing medium and heavy truck electrical and electronic systems.
- Work as a team member to develop a diagnostic strategy.
- Use blueprints and diagrams to execute a task.

INTEGRATION LINKAGES

Communication Skills, Teamwork Skills, Computer Skills, Reading and Writing Skills, Language Arts, Problem Solving, Interpersonal Skills, Employability Skills, Critical-Thinking Skills, SCANS (Secretary's Commission on Achieving Necessary Skills), National Institute for Automotive Service Excellence, National Automotive Technician Education Foundation,

DIESEL: ELECTRONICS

STANDARD 8.0

Students will demonstrate interpersonal and employability skills required in the diesel service industry.

LEARNING EXPECTATIONS

The student will:

8.1 Infer relationships between honesty, integrity, and organization and personal job success.
8.2 Demonstrate attitudes conducive to workplace success.
8.3 Maintain electrical and electronic equipment in a neat and orderly work area.
8.4 Assess implications of cultural and religious diversity for classroom and workplace relationships.
8.5 Develop individual and team time management and work sequencing skills to increase productivity in electrical and electronic systems diagnostics and repair.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

8.1.A Illustrates the concept of integrity.
8.1.B Assesses the potential impact of an individual's work ethic on an organizational system.
8.1.C Infers the relationship between organization and personal job success in electrical and electronics system servicing.
8.2.A Modifies behavior to increase productivity in the classroom, laboratory and workplace.
8.2.B Demonstrates awareness of activities occurring concurrently in the classroom and workplace.
8.3.A Keeps electrical and electronic equipment in a clean and organized work area.
8.3.B Maintains work area according to NATEF and OSHA standards.
8.3.C Recognizes the correlation between a clean orderly work environment and successful and efficient job in electrical and electronics systems servicing.
8.4.A Assesses benefits and predicts problems that may arise from diversity in work teams.
8.4.B Devises solutions to problems arising from gender, cultural, racial, and religious diversity.
8.5.A Assesses the benefits of incorporating time management principles into electrical and electronic system servicing.
8.5.B Displays time management and work sequencing skills in electrical and electronic system servicing.
8.5.C Demonstrates the ability to diagnose and repair electrical and electronic systems within manufacturers labor operation time.

SAMPLE PERFORMANCE TASKS

- Maintain an orderly work area.
- Lead a problem-solving team.
- Consistently arrive at class on time.
- Participate in an internship.
- Resolve an interpersonal conflict in the classroom.

INTEGRATION LINKAGES

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), Secretary's Commission on Achieving Necessary Skills (SCANS)

DIESEL: ELECTRONICS

SAMPLING OF AVAILABLE RESOURCES

T6 Electrical And Electronics Curriculum Module, AYES Corporation, www.ayes.org

2001 Medium/Heavy Duty Truck Task List, National Automotive Technicians Education Foundation (NATEF)

Diesel Technology: Workplace Skills, Instructional Materials Laboratory (IML), University of Missouri

Diesel Technology: Safety Skills, Instructional Materials Laboratory (IML), University of Missouri

Curriculum Integrator, CORD Communications, Waco, Texas 1998

Diesel Technology, Goodheart-Willcox, 2001